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3-10-06 Joanne Bourguignon

Date Joanne Bourguignon

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Joseph H. Steinmetz et al.

Application No.: 10/602,529

Filed: November 4, 2003

Title: Integrated-Circuit Implementation of a Storage-Shelf Router and a Path Controller Card for Combined use in High-Availability Mass-Storage-Device Shelves that May Be Incorporated within Disk Arrays

Examiner: Kim Ngoc Huynh

Art Unit: 2182

Docket No.: 35022.001C1

Date: March 10, 2006

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NOTIFICATION OF NON-COMPLIANT APPLEAL BRIEF UNDER 37 CFR § 41.37

Sir:

In response to the Appeal Brief filed November 14, 2005 and the Notification of Non-Compliant Appeal Brief under 37 CFR 41.37 dated February 10, 2006, Applicants respectfully submit an amended Appeal Brief that correctly contains a concise explanation of the subject matter defined in each of the independent claims involved in the appeal.

Applicants believe that no fee is required. However, at any time during the pendency of this application, please charge any fees required or credit any overpayment to Deposit Account No. 50-2976. A duplicate copy of this transmittal letter is enclosed.

Respectfully submitted,
Joseph H. Steinmetz et al.
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Enclosures:
Postcards
Amended Appeal Brief

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of:

Inventors:	Joseph H. Steinmetz et al.
Serial No.	10/602,529
Filed:	June 23, 2003
For:	Integrated-circuit implementation of a storage-shelf router and a path controller card for combined use in high-availability mass-storage-device shelves that may be incorporated within disk arrays

Examiner: Kim Hgoc Huynh

Group Art Unit: 2182

Docket No. 35022.001C1

Date: March 10, 2006

AMENDED APPEAL BRIEF

Mail Stop: Appeal Briefs – Patents
Commissioner of Patents and Trademarks
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This amended appeal is from the decision of the Examiner, in an Office communication mailed February 10, 2006, regarding notification of non-compliant appeal brief under 37 CFR 41.37.

REAL PARTY IN INTEREST

The real party in interest is Sierra Logic a Delaware Corporation and having a principal place of business at 9083 Foothills Blvd., Suite 300, Roseville, California 95747, U.S.A.

RELATED APPEALS AND INTERFERENCES

Applicants' representative filed on November 15, 2005, the same date as the original Appeal Brief is was filed, an Appeal Brief in response to a final rejection of claims 1-16 in U.S. Patent Application No. 10/702,065 which, like the current application, is assigned to Sierra Logic and which is directed to subject matter related to that of the current application.

STATUS OF CLAIMS

Claims 1-43 are pending in the application. Claims 1-3, 7-14 and 28-30 were finally rejected in the Office Action dated June 13, 2005. Applicants' appeal the final rejection of claims 1-3, 7-14 and 28-30, which are copied in the attached CLAIMS APPENDIX.

STATUS OF AMENDMENTS

An Amendment After Final is enclosed, which address the drawing issues.

SUMMARY OF CLAIMED SUBJECT MATTER

Overview

The present invention is directed to a single-integrated-circuit implementation ("single-IC") of a storage-shelf router. Storage-shelf routers are thoroughly described in the current application beginning at the top of page 33. The concept of a storage-shelf router is succinctly summarized in Figures 9-11 of the current application. A storage-shelf router (906 in Figure 9; 1014 and 1018 in Figure 10; 1102 and 1104 in Figure 11) is contained within a storage shelf (1010 in Figure 10; 1100 in Figure 11) is connected through one or more high-bandwidth communications media, such as fiber channel ("FC") communications media (908 in Figure 9; 1012 and 1016 in Figure 10) to an external processing entity, such as a disk-array controller (902 in Figure 9; 1006 in Figure 10), the external processing entity in turn interconnected with remote server and host computers (1002 and 1004 in Figure 10). The storage-shelf router is additionally connected, through mass-storage-device links (918 in Figure 9, 1028 in Figure 10), such as serial communications media, to a number of mass-storage devices within the storage shelf. One or more storage-shelf routers within a storage

shelf serve to interface the number of mass-storage devices within the storage shelf to the external processing entity.

In one embodiment of the present invention described in the current application, a disk-array controller is implemented to directly interface with FC disk drives. In these described embodiments of the present invention, one or more storage-shelf routers in a storage shelf present a set of virtual FC disk drives, via a storage-shelf-router-implemented storage-shelf interface, to the disk-array controller, but the storage shelf actually contains cheaper ATA and/or SATA disk drives, rather than the more expensive FC disk drives with which the disk-array controller is designed to interface. The storage-shelf routers translate SCSI commands embedded within FC frames by the disk-array controller to ATA and SATA commands that the storage-shelf routers then forward to the ATA and/or SATA disk drives via serial links. The storage-shelf routers thus both translate SCSI commands to ATA commands and ATA command responses to SCSI command responses as well as bridge FC communications media to ATA and/or SATA communications links.

The described embodiments of the present invention concern storage-shelf routers within storage shelves accessed via FC communications media by a disk-array controller, the storage shelf containing ATA and/or SATA disk drives to which the disk-array controller cannot directly interface. However, the current application is more generally directed to storage-shelf routers and interface-tunneling mechanisms that allow any of a variety of different types of external processing entities to directly interface to physical mass-storage devices within a storage shelf and, in particular, to send a small number of mass-storage-device-type-specific testing, maintenance, and update commands to the mass-storage devices when the external processing entities do not support a general, direct interface to the mass-storage devices.

One embodiment of the present invention is a single-IC storage-shelf router, used in combination with path controller cards and optionally with other single-IC storage-shelf routers, to interconnect SATA disks within a storage shelf or disk array to a high-bandwidth communications medium, such as an FC arbitrated loop. An overview of one embodiment of the claimed single-IC storage-shelf router is shown in Figure 15, of the current application and described beginning on line 12 of page 40 of the current application with reference to Figure 15. The single-IC storage router includes the major functional components shown in Figure 15, including two FC ports 1502 and 1504, a dual-CPU processing complex 1512, routing and FCP-protocol logic 1506 and 1508, a global shared

memory switch 1510, and a large number of SATA ports 1512-1518. Thus, the single-IC storage-shelf router to which the current application is directed includes ports to two separate instances of a first type of communications medium by which a storage shelf is interconnected to external processing entities, such as disk-array controllers, a number of ports to mass-storage devices interconnected to the storage-shelf router through a number of instances of a second type of communications medium, in the described embodiment of the present invention, serial SATA links, and complex logic for translating and routing commands from the first type of communications medium to the second type of communications medium, and for translating and routing responses from the second type of communications medium to the first type of communications medium.

The FC ports of the storage-shelf router (1502 and 1504 in Figure 15) are generally interconnected with corresponding FC ports of a disk-array controller or other external processing entity. The SATA ports (1512-1518) of the storage-shelf router are generally connected to path-controller cards, two examples of which are shown in Figures 14A-B. The path-controller cards provide two separate ports to two separate instances of a storage-device communications media, to provide fault tolerance within a storage shelf, and include additional logic and features to reliably interconnect a single mass-storage device, such as an ATA or SATA disk drive, to both ports, and via both ports, to two corresponding ports of one or more storage-shelf routers. Additional details of the single-IC storage-shelf router to which the current application and claims are directed are provided in Figures 17A-23, and are described in detail in the current application beginning on line 19 of page 44.

As can be readily appreciated by those familiar with disk arrays and high-availability storage shelves, a single-integrated-circuit implementation of a storage-shelf router is not a trivial undertaking. The single-IC implementation of the storage-shelf router described in the current application features many layers of extremely complex logic, and highly parallel processing of streams of information input through the FC ports to generate corresponding ATA and SATA commands transmitted by the single-IC storage-shelf router to mass-storage devices within the storage shelf. Similarly, highly efficient and parallel processing of command responses and data returned by the mass-storage devices to the storage-shelf router is undertaken in order to return the command responses and data through the FC ports to external processing entities, such as disk-array controllers.

The present invention is directed to a single-integrated-circuit implementation ("single-IC") of a storage-shelf router. Storage-shelf routers are thoroughly described in the current application beginning at the top of page 33. The concept of a storage-shelf router is succinctly summarized in Figures 9-11 of the current application. A storage-shelf router (906 in Figure 9; 1014 and 1018 in Figure 10; 1102 and 1104 in Figure 11) is contained within a storage shelf (1010 in Figure 10; 1100 in Figure 11) is connected through one or more high-bandwidth communications media, such as fiber channel ("FC") communications media (908 in Figure 9; 1012 and 1016 in Figure 10) to an external processing entity, such as a disk-array controller (902 in Figure 9; 1006 in Figure 10), the external processing entity in turn interconnected with remote server and host computers (1002 and 1004 in Figure 10). The storage-shelf router is additionally connected, through mass-storage-device links (918 in Figure 9, 1028 in Figure 10), such as serial communications media, to a number of mass-storage devices within the storage shelf. One or more storage-shelf routers within a storage shelf serve to interface the number of mass-storage devices within the storage shelf to the external processing entity.

<u>Independent Claim 1</u>

Independent claim 1 claims a storage shelf (1010 in Figure 10; 1100 in Figure 11; 1500 in Figure 15) that includes a first storage-shelf-router integrated circuit and a last storage-shelf-router integrated circuit, both storage-shelf-router integrated circuits (906 in Figure 9; 1014 and 1018 in Figure 10; 1102 and 1104 in Figure 11; 1500 in Figure 15) claimed to include basic components shown in Figure 15. The storage shelf is additionally claimed to contain a number of path-controller cards, such as the path-controller cards (*see* discussion beginning on line 1 of page 39 of the Current Application) discussed above and shown in Figures 14A-B of the current application.

<u>Dependent Claims 2 – 8</u>

Dependent claims 2 and 3 are directed to the storage shelf of claim 1 and further including interconnection of the two storage-shelf routers to one another and to two external communications media, as shown for storage shelves 1 and 2 in Figure 25 of the current application. Dependent claims 4-6 are directed to methods by which single-IC storage-shelf routers within a storage shelf are assigned unique numbers. Dependent claims 7 and 8 specifically claim described embodiments of the storage shelf described in the current

application, including storage shelves using ATA and SATA mass-storage devices and interconnected with external processing entities through FC communications media.

Independent Claim 9

Independent claim 9 is directed to a single-IC storage-shelf router (906 in Figure 9; 1014 and 1018 in Figure 10; 1102 and 1104 in Figure 11; 1500 in Figure 15) as shown in Figure 15 of the current application and as discussed above.

Dependent Claims 10 – 29

Dependent claims 10-29 add specific details and features of the single-IC storage-shelf router claimed in claim 9. For example, claim 10 includes first-in-first-out buffers (1706 and 1707 in Figure 17A), claim 11 specifies parallel operation of the first-in-first-out buffers by other components of the storage-shelf router, claim 12 discusses how routing logic directs received commands to a shared memory component within the storage-shelf router, and claim 13 includes a global-shared-memory switch and virtual queues. Claims 14-27 are directed to various facets of operation of the routing logic (1506 in Figure 15) including the routing layer of the single-IC storage-shelf router of claim 9. Claims 28 and 29 specify details of described embodiments of the storage-shelf router in the current application, including the types of internal storage-shelf communications media and communications media interconnecting a storage shelf that includes storage-shelf routers to an external processing entity.

Independent Claim 30

Independent claim 30 is directed to the routing layer (1506 in Figure 15) of s single-IC-storage-shelf-router (906 in Figure 9; 1014 and 1018 in Figure 10; 1102 and 1104 in Figure 11; 1500 in Figure 15) embodiment of the present invention.

Dependent Claims 31 – 43

Claims 31-43 are directed to specific features and to operation of the routing layer (1506 in Figure 15) of the single-IC storage-shelf router to which the current application is directed.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 9-14 and 30 are anticipated under 35 U.S.C. § 102(b) by Hoese, U.S. Patent No. 5,941,972 ("Hoese").

2. Whether claims 1-3 and 7-8 are obvious under 35 U.S.C. § 103(a) over Hoese in view of Walsh et al., U.S. Patent Application Publication No. 2002/0099972 ("Walsh).

3. Whether claims 7-8 and 28-30 are obvious under 35 U.S.C. § 103(a) over Hoese in view of Walsh and in further view of Bissessur et al., U.S. Patent No. 6,820,140 ("Bissessur").

ARGUMENT

Claims 1-43 are pending in the current application. In an Office Action dated June 13, 2005 ("Office Action"), the Examiner rejected claims 9-14 and 30 under 35 U.S.C. § 102(b) as being anticipated by Hoese et al., U.S. Patent No. 5,941,972 ("Hoese"), rejected claims 1-3 and 7-8 under 35 U.S.C. § 103(a) over Hoese in view of Walsh et al., U.S. Patent Publication No. 2002/0099972 A1 ("Walsh"), and rejected claims 7-8 and 28-30 under 35 U.S.C. § 103(a) as being obvious over Hoese in view of Walsh and further in view of Bissessur et al., U.S. Patent No. 6,820,140 B2 ("Bissessur"). Applicants respectfully traverse the 35 U.S.C. § 102(b) and 35 U.S.C. § 103(a) rejections of claims 1-3, 7-14, and 28-30.

ISSUE 1

1. <u>Whether claims 9-14 and 30 are anticipated under 35 U.S.C. § 102(b) by Hoese, U.S. Patent No. 5,941,972 ("Hoese").</u>

Hoese discloses a storage router (56 in Figure 3 of Hoese) that interconnects work stations (58 in Figure 3 of Hoese), connected to one another via a fibre channel communications medium (52 in Figure 3 of Hoese), with storage devices (60, 62, and 64 in Figure 3) connected with one another and the storage router via a SCSI bus (54 in Figure 3). Hoese's storage router is shown in greater detail in Figures 4 and 5 of Hoese. Hoese's storage router includes a fibre channel controller (80 in Figure 4) and a SCSI controller (82 in Figure

4), the fibre channel controller interconnected to a single fibre channel medium and the SCSI controller interconnected to a single SCSI bus 54. Beginning on line 51 of column 5, Hoese describes the physical implementation of the storage router. Hoese states that:

> . . . the *storage router can be a rack mount or free standing device with an internal power supply.* The storage router can have a Fibre Channel and SCSI port, and a standard, detachable power cord can be used, the FC connector can be a copper DB9 connector, and the SCSI connector can be a 68-pin type. Additional modular jacks can be provided for a serial port and a 802.3 10BaseT port, i.e. twisted pair Ethernet, for management access. The SCSI port of the storage router an support SCSI direct and sequential access target devices and can support SCSI initiators, as well. The Fibre Channel port can interface to SCSI-3 FCP enabled devices and initiators.
>
> To accomplish its functionality, one implementation of *the storage router uses*: a Fibre Channel interfaced based on the *HEWLETT-PACKARD TACHYON HPFC-5000 controller* and a GLM media interface; *an Intel 80960RP processor*, incorporating independent data and program memory spaces, and associated logic required to implement a stand alone processing system; and a serial port for debug and system configuration. Further, this implementation includes a SCSI interface supporting Fast-20 based on the SYMBIOS 53C8xx series SCSI controllers, *and an operating system based upon the WIND RIVERS SYSTEMS VXWORKS or IXWORKS kernel, as determined by design. In addition, the storage router includes software as required to control basic functions of the various elements, and to provide appropriate translations between the FC and SCSI protocols.* (emphasis added)

Claim 9 is provided, below, for the convenience of the reader:

> 9. A storage-shelf-router integrated circuit employed within a storage shelf that contains a number of data-storage devices interconnected to two communications media, the storage-shelf-router integrated circuit including:
>
> a first communications-medium port;
>
> a second communications-medium port;
>
> one or more processors;
>
> a number of data-storage-device-link-port components that transmit data and commands to the number of data-storage devices through disk-drive links; and
>
> routing logic for routing commands received through the first and second communications-medium ports to the one or more processors and for routing data received through the two or more communications-medium ports to the number of data-storage-device-link-port components.

Thus, as described above, the claimed storage-shelf router is a single integrated circuit that includes two communications ports, a number of data-storage-device-link ports, and routing logic that routes commands received through the two

communication media ports to the number of data-storage-device-link ports. The fact that the claimed storage-shelf router is a single integrated circuit is clearly and repeatedly stated in the current application, including in the title, in the Summary of the Invention section at lines 24-25 of page 26 and lines 4-5 of page 27, and throughout the Detailed Description of the Invention section of the current application.

In rejecting claims 9-14 and 30, the Examiner states:

> Claim 9, Hoese discloses (Figs. 2-5) a storage shelf router 56 employed within a storage shelf 62 (rack mount, col. 5, II. 50-53) containing a plurality of storage devices 66-72, two communication media ports (connecting to 32 and 34), disk drive links and link port components (disk drive interface/controller) for transmitting data/commands to the storage devices, at least one processor (80-86, see Fig. 4-5) and routing logic for routing commands received from the communications-medium ports to the link port component.

First, the Examiner draws an equivalence between Applicants' claimed first and second communications-medium ports and the fibre channel (32 in Figure 2) and SCSI bus (34 in Figure 2) interconnected with Hoese's storage router. However, claim 9 also includes, in the single-IC storage-shelf router, a number of data-storage-device-link-port components, which the Examiner mentions, but fails to point to equivalent components in Hoese's storage router in the rejection of claim 9. In fact, as shown in more detail in Figures 4 and 5 of Hoese, Hoese does not include additional data-storage-device-link-port components, because Hoese's storage router does not directly interconnect with the storage devices, but instead interconnects with the storage devices via the SCSI bus which the Examiner has already assigned as being equivalent to one of Applicants' claimed first and second communications-medium ports. Thus, Hoese's storage router clearly lacks the "number of data-storage-device-link-port components" element of claim 9. For this reason alone, Hoese cannot possibly anticipate Applicants' claimed storage-shelf router. Furthermore, the Examiner claims that Hoese discloses "routing logic for routing commands received from the communications-medium ports to the link port component," but does not point to any disclosed component in the text or figures of Hoese to support the claim. In particular, the Examiner fails to point to a link port in Hoese's storage router. In fact, there is no such routing component in Hoese, because Hoese lacks the "number of data-storage-device-link-port components" element of claim 9. Furthermore, Hoese does not explicitly mention routing of commands to one or more processors, as is claimed in claim 9.

Thus, it appears that the Examiner has selectively drawn equivalences between certain of the claimed elements of the single-IC storage-shelf router claimed in claim 9, but has failed to point to equivalences between other claim elements of claim 9 in the cases that no equivalent structures or components can be found in Hoese's storage router. However, the Examiner's greatest omission concerns the fact that Applicants claim a single-IC storage-shelf router. The term "integrated circuit" is defined, by the Microsoft Press Computer Dictionary, Second Edition, as follows: "Abbreviated IC; also called a chip. In electronics, the packing of circuit elements, such as transistors and resistors, onto a single chip of silicon crystal or other material."

Applicants' representative has pointed out this fact to the Examiner in a previous response, to which the Examiner replies in the Office Action as follows:

> Applicant's argument based on the assumption that the shelf router of Hoese is not an integrated circuit, the examiner respectfully disagrees with this assumption. System On a Chip (SOC) has become common practice in computer technology by places the contents of many integrated circuits onto a single semiconductor chip to create a design that contains all the major elements of a system in one integrated chip. Hoese discloses an integrated circuit (Intel 80960RP processor) to incorporate independent data memory spaces and associated logic requirement to implement a stand-alone processing system (col. 5, I. 63 to col. 6, I. 11) to accomplish the functionality of the storage router and also includes SCSI and FC ports (col. 5, II. 53-54) and links connecting to the SCSI bus 54 to the storage devices 60-74. It is unclear how applicant concludes that the router of Hoese is not an integrated circuit and does not include ports and links.

It is clear from the above-quoted section of Hoese that Hoese's storage router cannot possibly be an integrated circuit. First of all, integrated circuits are not rack-mounted or free-standing devices with internal power supplies. Integrated circuits do not contain power supplies, and integrated circuits are far too small and fragile to be rack mounted or free-standing devices. Integrated circuits do not contain 68-pin-type SCSI connectors nor do integrated circuits contain modular jacks for serial ports and 802.3 10BaseT ports. Perhaps most telling is that Hoese describes various components included in Hoese's storage router. These components include a Hewlett-Packard Tachyon HPFC-5000 Controller, a GLM media interface, and an Intel 80960RP processor. Applicants' Representative can think of no single integrated circuit that can possibly contain an HP Tachyon chip as well as an Intel 80960RP processor. Integrated circuits are produced by complex integrated-circuit-fabrication facilities, generally owned by a single company. Applicants' representative had

the privilege to draft a number of patent applications related to the HP Tachyon Controller. The HP Tachyon Controller is a single integrated chip. Moreover, it is a rather large integrated circuit. The Intel 80960RP processor is also an integrated circuit. Thus, Hoese's storage router contains at least two different integrated circuits. But Hoese's storage router also includes an operating system based on the Wind Rivers VXWORKS kernel, as well as additional software as required to control basic functions of the various elements. Integrated circuits do not contain software, by definition.

Claim 9 claims a "storage-shelf-router integrated circuit employed within a storage shelf." Hoese, by contrast, discloses a storage router that is a rack-mounted or free-standing device that includes a number of different components, including a number of different integrated circuits manufactured by different vendors, operating systems, software, SCSI connectors, power supplies, and many other components. Hoese is clearly not an integrated circuit, either by a standard definition of an integrated circuit provided above, or by common understanding of the term "integrated circuit" in the electronics industry. Hoese therefore cannot possibly anticipate the single-IC storage-shelf router claimed in claim 9, and all claims that depend from claim 9.

Claim 30 claims routing logic within a storage-shelf router that routes messages received from one of two first and second communications media either to a remote storage-shelf router, through a remote external entity, to a command and error processing component of the storage-shelf router, or to a data-storage-link-port layer of the storage-shelf router. The Examiner appears to read almost all of the elements of claim 30 onto a general description of various different hardware and software components included within one embodiment of Hoese's storage router. However, this list of hardware components does not teach, mention, or suggest the types of routing operations claimed in claim 30. Furthermore, the Examiner mentions a number of components that are not listed in the cited portion of Hoese, including a serial port debugger, OSI layer 2 data link layer via the FC and SCI interface, and an error processing component. The Examiner states that Hoese teaches, in lines 12-16 of column 6, "routing logic having destination logic determines a message received from one of the ports and a routing logic for forwarding the message to the appropriate destination based on the destination address of the command, and routes the message received from one of the port designates for the local storage-shelf router to the command and error-processing component or data-storage-link-port layer of the router." While Applicants' Representative cannot fully parse or understand the Examiner's statement,

Applicants' Representative can confidently state that the cited lines of Hoese teach nothing of the sort. Instead, the cited lines of Hoese describe two of four modes of operation for Hoese's storage router. One mode of operation allows for interchange between an FC initiator and a SCSI target, and another mode of operation provides for interchange between a SCSI initiator and an FC target. Nothing in the cited lines mention data-storage-link-port layers, destination addresses of commands, or error-processing components, as claimed by the Examiner.

In short, Hoese discloses a large, free-standing or rack-mounted device for interconnecting an FC communications medium to a SCSI communications medium. Hoese does not disclose an integrated circuit implementation of a storage-shelf router, does not disclose a storage-shelf router with two communications ports to two communications media as well as a number of data-storage-device-link-port components. Hoese does not even disclose or mention a storage shelf, as described and claimed in the current application. Hoese is essentially unrelated to the single-IC storage-shelf router to which the current application and current claims are directed.

ISSUE 2

2. Whether claims 1-3 and 7-8 are obvious under 35 U.S.C. § 103(a) over Hoese in view of Walsh et al., U.S. Patent Application Publication No. 2002/0099972 ("Walsh).

Claim 1 is provided below for the reader's convenience:

1. A storage shelf that contains a number of data-storage devices interconnected to a communications medium, the storage shelf including:

a first storage-shelf-router integrated circuit and a last storage-shelf-router integrated circuit, each storage-shelf router integrated circuit including

a first communications-medium port,

a second communications-medium port,

one or more processors,

a number of disk-drive-link-port components that transmit data and commands to the number of data-storage devices through disk-drive links, and

routing logic for routing commands received through the first and second communications-medium ports to the one or more processors and for routing data received through the two or more communications-medium ports to the number of data-storage-device-link-port components; and

a number of path controller cards, each path controller card

receiving data and commands transmitted through disk-drive links from the number of data-storage-device-link-port components of one of

> the two storage-shelf-router integrated circuits, and, following a failure of a disk-drive link or data-storage-device-link port, receiving data and commands transmitted from one or more of the number of data-storage-device-link-port components of the other of the storage-shelf-router integrated circuits, and
> transmitting the received data and commands to a data-storage device.

Claim 1 includes, as a first element, a first storage-shelf-router integrated circuit and a last storage-shelf-router integrated circuit. As discussed above, in the previous section, Hoese does not disclose an integrated-circuit implementation of a storage-shelf router. Moreover, as discussed above, Hoese does not disclose a storage-shelf router that includes a first and second communications-medium ports as well as a number of disk-drive-link-port components, nor does Hoese disclose or suggest a storage shelf, as described and claimed in the current application. The Examiner's 35 U.S.C. § 103(a) obviousness-type rejection of claims 1-3 and 7-8 depend on Hoese for teaching or suggesting the first element of claim 1, namely the storage-shelf router integrated circuits. Therefore, the Examiner's 35 U.S.C. § 103(a) obviousness-type rejections based primarily on Hoese fail for much the same reason that the Examiner's 35 U.S.C. § 102(b) anticipation rejections, discussed in the previous section, fail.

Claim 1 also claims a number of path-controller cards that receive data and commands transmitted through disk-drive links from the number of data-storage-device-link-port components to one of the two storage-shelf-router integrated circuits, with the path-controller cards failing over to receiving data and commands from another of the storage-shelf-router integrated circuits upon failure of a disk-drive link or data-storage-device-link port. Hoese clearly does not teach, mention, or suggest the claimed path-controller cards. Therefore, the Examiner cites Walsh as disclosing path-controlling cards. However, Walsh does not use the term "path-controller card," and does not disclose anything similar to Applicants' claimed path-controller cards, examples of which are shown in Figures 14A-B of the current application. Instead, Walsh discloses bridge hotswap cards ("BHC"). An exemplary BHC is shown in Figure 3, and is described in paragraph [0035] of Walsh. The BHC cards are simply network bridge cards that interconnect various PCI busses, Ethernet busses, and other internal cards within Walsh's network router device. The path-controller cards of the current application interconnect a disk drive with two different disk-drive links in order to provide high-availability connection between the disk drive and a storage-shelf router. There is no indication in Walsh, either in Figure 3 or the text referring to Figure 3,

that Walsh's BHC cards are intended to provided high-availability connections to any kind of mass-storage device, let alone a disk drive. Walsh's BHC cards are not described as providing failover functionality for high-availability connections of disk drives to storage-shelf routers. Instead, Walsh explicitly states that the BHC cards serve as PCI bus extenders and support hot-swap card management and selection of a master RCP via interaction with the common I/O card which serves as a network management access point (Walsh, paragraph [0037]). The router control processes ("RCPs") of Walsh are not storage-shelf routers, but are instead control processors used within network switches or network routers (Walsh, paragraphs [0004] and [0009]). Walsh does not disclose or mention storage devices, storage shelves, disk arrays, or anything else even remotely related to the storage-shelf router and storage shelf to which the current application and claims are directed.

At the end of the rejection, the Examiner states that, "It would have been obvious to one having ordinary skill in the art to utilize the teaching of redundant router integrated circuits and path-controller cards of Walsh in order to provide a reliable control plane in case of failure of any single component of the control plane as taught by Walsh." Claim 1 does not mention control planes or reliable control planes. Claim 1 is, instead, directed to a storage shelf that contains storage-shelf-router integrated circuits and path-controller cards. Walsh is related to network routers, rather than to mass-storage devices. The motivation for combining Walsh with Hoese, as clearly stated by the Examiner, would produce a rack-mounted storage router for interconnecting an FC communications medium with a SCSI-2 communications medium, as disclosed by Hoese, with a reliable control plane. However, claim 1 is not directed to such a device, but is instead directed to a storage shelf. Claim 1, and claims 2-3 and 7-8 that depend from claim 1, are clearly not made obvious by Hoese alone, Walsh alone, or Hoese and Walsh in combination. Walsh is unrelated both to Hoese and to the storage shelf to which the current claims are directed. Hoese does not disclose, mention, or suggest the storage-shelf-router integrated circuits of claim 1. No combination of Hoese and Walsh can therefore teach or suggest the claimed storage shelf of claim 1.

ISSUE 3

3. Whether claims 7-8 and 28-30 are obvious under 35 U.S.C. § 103(a) over Hoese in view of Walsh and in further view of Bissessur et al., U.S. Patent No. 6,820,140 ("Bissessur").

As discussed in the previous section, neither Hoese, nor Walsh, nor Hoese and Walsh in combination teach, mention, or suggest the subject matter of independent claims 1, 9, and 30. The current application is directed to a storage shelf and single-IC storage-shelf router, while Hoese discloses a large, rack-mounted or stand-alone storage router completely dissimilar in function and structure to the storage shelf and single-IC-storage-shelf router to which the current application and current claims are directed. Bissessur adds nothing to the Examiner's arguments. Bissessur is cited by the Examiner for the proposition that a network adaptor or network controller can interface both to a fibre channel communications medium as well as to a SATA controller. Indeed, the fibre channel was developed to allow various types of mass-storage-device protocols to be embedded within fibre-channel frames for transport across high-bandwidth fibre channel communications media. Embedding various types of protocols, including the SCSI protocol, within fibre channel frames is discussed in detail in the background section of the current application. However, Bissessur does not teach, mention, or suggest storage shelves, storage-shelf routers, single-IC storage shelf routers, path-controller cards, or any of the numerous other claimed elements of the present invention which Hoese and Walsh fail to teach, mention, or suggest.

CONCLUSION

In summary, as discussed in detail above, Hoese, Walsh, and Bissessur are essentially unrelated to the claimed storage shelf and single-IC storage-shelf router to which the current application and current claims are directed. None of the references teach, suggest, or mention storage shelves, as defined in the current application, storage-shelf routers, or single-IC implementations of storage-shelf routers. Hoese essentially discloses a type of network bridge. Walsh discloses a network switch or network router. Bissessur discloses transfer of data requests between a bus master and disk controller in a convention disk array. The Examiner has failed to point out many of the claim elements in the cited references, and has maintained that Hoese's storage router is an integrated circuit, when it cannot possibly be, according to Hoese's detailed description. There is no basis in the cited references for either an anticipation rejection or an obviousness-type rejection of any claim in the current application.

Applicant respectfully submits that all statutory requirements are met and that

the present application is allowable over all the references of record. Therefore, Applicant respectfully requests that the present application be passed to issue.

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CLAIMS APPENDIX

1. A storage shelf that contains a number of data-storage devices interconnected to a communications medium, the storage shelf including:

a first storage-shelf-router integrated circuit and a last storage-shelf-router integrated circuit, each storage-shelf router integrated circuit including

a first communications-medium port,

a second communications-medium port,

one or more processors,

a number of disk-drive-link-port components that transmit data and commands to the number of data-storage devices through disk-drive links, and

routing logic for routing commands received through the first and second communications-medium ports to the one or more processors and for routing data received through the two or more communications-medium ports to the number of data-storage-device-link-port components; and

a number of path controller cards, each path controller card

receiving data and commands transmitted through disk-drive links from the number of data-storage-device-link-port components of one of the two storage-shelf-router integrated circuits, and, following a failure of a disk-drive link or data-storage-device-link port, receiving data and commands transmitted from one or more of the number of data-storage-device-link-port components of the other of the storage-shelf-router integrated circuits, and

transmitting the received data and commands to a data-storage device.

2. The storage shelf of claim 1 wherein the storage shelf is interconnected to a first communications medium and to a second communications medium, and wherein the number of storage-shelf-router integrated circuits are linked together in a first series, the first series comprising:

the first communications medium;

the first storage-shelf-router integrated circuit connected to the first communications medium through the first communications-medium port of the first storage-shelf-router and connected to the last storage-shelf-router integrated circuit through the

second communications-medium port of the first storage-shelf-router integrated circuit, the first communications-medium port of the last storage-shelf-router integrated circuit, and an internal communications medium; and

the last storage-shelf-router integrated circuit.

3. The storage shelf of claim 2 wherein the number of storage-shelf-router integrated circuits are linked together in a second series, the second series comprising:

the second communications medium;

the last storage-shelf-router integrated circuit connected to the second communications medium through the second communications-medium port of the last storage-shelf-router and connected to the first storage-shelf-router integrated circuit through the first communications-medium port of the last storage-shelf-router integrated circuit, the second communications-medium port of the last storage-shelf-router integrated circuit, and the internal communications medium; and

the first storage-shelf-router integrated circuit.

4. The storage shelf of claim 3 further including additional storage-shelf-router integrated circuits, each storage-shelf router integrated circuit linked together in the first series and the second series in between the first storage-shelf-router integrated circuit and the last storage-shelf-router integrated circuit, the storage-shelf-router integrated circuits each assigned a unique number, the first storage-shelf-router integrated circuit assigned a lowest unique number, the last storage-shelf-router integrated circuit assigned a highest unique number, the unique numbers assigned to the additional storage-shelf-router integrated circuits increasing along the first series and decreasing along the second series.

5. The storage shelf of claim 4 wherein each additional storage-shelf-router integrated circuit having an assigned unique number is linked to a storage-shelf-router integrated circuit with a lower unique number than the assigned unique number through the first communications-medium port of the additional storage-shelf-router, the second communications-medium port of the storage-shelf-router integrated circuit with a lower unique number than the assigned unique number, and an internal communications medium connecting the additional storage-shelf-router integrated circuit with the storage-shelf-router integrated circuit with a lower unique number than the assigned unique number.

6. The storage shelf of claim 4 wherein each additional storage-shelf-router integrated circuit having an assigned unique number is linked to a storage-shelf-router integrated circuit with a higher unique number than the assigned unique number through the second communications-medium port of the additional storage-shelf-router, the first communications-medium port of the storage-shelf-router integrated circuit with a higher unique number than the assigned unique number, and an internal communications medium connecting the additional storage-shelf-router integrated circuit with the storage-shelf-router integrated circuit with a higher unique number than the assigned unique number.

7. The storage shelf of claim 1

wherein the communications medium is a fibre channel arbitrated loop, and

wherein each of the number of data-storage devices is an Advanced Technology Attachment disk drive.

8. The storage shelf of claim 1

wherein the communications medium is a fibre channel arbitrated loop,

wherein each of the number of data-storage devices is a Serial Advanced Technology Attachment disk drive, and

wherein the number of data-storage-device-link-port components are Serial Advanced Technology Attachment ports.

9. A storage-shelf-router integrated circuit employed within a storage shelf that contains a number of data-storage devices interconnected to two communications media, the storage-shelf-router integrated circuit including:

a first communications-medium port;

a second communications-medium port;

one or more processors;

a number of data-storage-device-link-port components that transmit data and commands to the number of data-storage devices through disk-drive links; and

routing logic for routing commands received through the first and second communications-medium ports to the one or more processors and for routing data received

through the two or more communications-medium ports to the number of data-storage-device-link-port components.

10. The storage-shelf-router integrated circuit of claim 9 wherein each of the two communications-medium ports include a first-in-first-out buffer into which commands and data received by the communications-medium port are written, and from which command and data received by the communications-medium port are accessed by the routing logic.

11. The storage-shelf-router integrated circuit of claim 10 wherein the routing logic may access an initial portion of a command or data from the first-in-first-out buffer while the communications-medium port is writing a latter portion of the command or data into the first-in-first-out buffer.

12. The storage-shelf-router integrated circuit of claim 10 wherein the routing logic routes commands accessed from the first-in-first-out buffer within the two communications-medium ports to the one or more processors by directing the commands to a storage-shelf-router-integrated-circuit module that writes the commands to a shared memory, from which the commands can be accessed by the one or more processors.

13. The storage-shelf-router integrated circuit of claim 10 wherein the routing logic routes data accessed from the first-in-first-out buffer within the two communications-medium ports to the number of data-storage-device-link-port components by directing the data to a storage-shelf-router-integrated-circuit module that writes the data to a virtual queue within a global-shared-memory switch, from which the data can be accessed by the one of the one or more number of data-storage-device-link-port components.

14. The storage-shelf-router integrated circuit of claim 9 wherein the storage-shelf-router integrated circuit is assigned a unique number and is linked through the first communications-medium port and a first communications medium to a first entity and is linked through the second communications-medium port and a second communications medium to a second entity, the first entity one of

a remote device external to the storage shelf, and

a storage-shelf-router integrated circuit having a unique number less than the assigned unique number, and

the second entity one of

a remote device external to the storage shelf, and

a storage-shelf-router integrated circuit having a unique number greater than the assigned unique number.

15. The storage-shelf-router integrated circuit of claim 14 wherein the storage-shelf-router integrated circuit further includes a routing table that lists, for each data-storage device interconnected through the number of data-storage-device-link-port components to the storage-shelf-router integrated circuit, a first-communications-medium address associated with the data-storage device, a second-communications-medium address associated with the data-storage device, and additional information related to the data-storage-device addresses supported by the data-storage device.

16. The storage-shelf-router integrated circuit of claim 15 wherein, when the routing logic accesses a command message received through the first communications-medium port, the routing logic

routes the command message to one of the one or more processors when a destination address of the command message matches a first-communications-medium address associated with a data-storage device in the routing table,

routes the command message to the second communications-medium port when the destination address of the command message does not match a first-communications-medium address associated with a data-storage device in the routing table, and the second entity is not a remote device external to the storage shelf,

routes the command message to the first communications-medium port when the destination address of the command message does not match a first-communications-medium address associated with a data-storage device in the routing table, and the second entity is a remote device external to the storage shelf, and

routes the command message to one of the one or more processors when the routing logic determines that the command message needs error handling.

17. The storage-shelf-router integrated circuit of claim 16 wherein the routing logic determines that the command message needs error handling when the routing logic accesses additional tables within the storage-shelf-router integrated circuit and determines that the entity which sent the command message is not authorized to direct a command to a data-storage device interconnected to the storage-shelf router.

18. The storage-shelf-router integrated circuit of claim 15 wherein, when the routing logic accesses a data message received through the first communications-medium port, the routing logic

routes the data message to one of the number of data-storage-device-link-port components when a destination address of the command message matches a first-communications-medium address associated with a data-storage device in the routing table,

routes the data message to the second communications-medium port when the destination address of the command message does not match a first-communications-medium address associated with a data-storage device in the routing table, and the second entity is not a remote device external to the storage shelf,

routes the data message to the first communications-medium port when the destination address of the command message does not match a first-communications-medium address associated with a data-storage device in the routing table, and the second entity is a remote device external to the storage shelf, and

routes the data message to one of the one or more processors when the routing logic determines that the data message needs error handling.

19. The storage-shelf-router integrated circuit of claim 18 wherein the routing logic determines that the data message needs error handling when the routing logic accesses additional tables within the storage-shelf-router integrated circuit and determines that no context has been created within shared memory during processing of a previous command message for a data transfer operation, all or a portion of which involves the data message and when the routing logic accesses additional tables within the storage-shelf-router integrated circuit and determines that the entity which sent the command message is not authorized to direct data to a data-storage device interconnected to the storage-shelf router.

20. The storage-shelf-router integrated circuit of claim 15 wherein, when the routing logic accesses a status message received through the first communications-medium port, the routing logic

routes the status message to the second communications-medium port when the second entity is not a remote device external to the storage shelf, and

routes the status message to the first communications-medium port when the second entity is a remote device external to the storage shelf.

21. The storage-shelf-router integrated circuit of claim 15 wherein, when the routing logic accesses a storage-shelf-internal-management message received through the first communications-medium port, the routing logic

routes the storage-shelf-internal-management message to one of the one or more processors when a destination address of the storage-shelf-internal-management message matches the unique number assigned to the storage-shelf-router integrated circuit,

routes the storage-shelf-internal-management message to the second communications-medium port when the destination address of the storage-shelf-internal-management message is greater than the unique number assigned to the storage-shelf-router integrated circuit and the second entity is not a remote device external to the storage shelf, and

routes the storage-shelf-internal-management message to one of the one or more processors when the routing logic determines that the storage-shelf-internal-management message needs error handling.

22. The storage-shelf-router integrated circuit of claim 15 wherein, when the routing logic accesses a command message received through the second communications-medium port, the routing logic

routes the command message to one of the one or more processors when a destination address of the command message matches a second-communications-medium address associated with a data-storage device in the routing table,

routes the command message to the first communications-medium port when the destination address of the command message does not match a second-communications-medium address associated with a data-storage device in the routing table, and the first entity is not a remote device external to the storage shelf,

routes the command message to the second communications-medium port when the destination address of the command message does not match a second-communications-medium address associated with a data-storage device in the routing table, and the first entity is a remote device external to the storage shelf, and

routes the command message to one of the one or more processors when the routing logic determines that the command message needs error handling.

23. The storage-shelf-router integrated circuit of claim 22 wherein the routing logic determines that the command message needs error handling when the routing logic accesses additional tables within the storage-shelf-router integrated circuit and determines that the entity which sent the command message is not authorized to direct a command to a data-storage device interconnected to the storage-shelf router.

24. The storage-shelf-router integrated circuit of claim 15 wherein, when the routing logic accesses a data message received through the second communications-medium port, the routing logic

routes the data message to one of the number of data-storage-device-link-port components when a destination address of the command message matches a second-communications-medium address associated with a data-storage device in the routing table,

routes the data message to the first communications-medium port when the destination address of the command message does not match a second-communications-medium address associated with a data-storage device in the routing table, and the first entity is not a remote device external to the storage shelf,

routes the data message to the second communications-medium port when the destination address of the command message does not match a second-communications-medium address associated with a data-storage device in the routing table, and the first entity is a remote device external to the storage shelf, and

routes the data message to one of the one or more processors when the routing logic determines that the data message needs error handling.

25. The storage-shelf-router integrated circuit of claim 24 wherein the routing logic determines that the data message needs error handling when the routing logic accesses additional tables within the storage-shelf-router integrated circuit and determines that no

context has been created within shared memory during processing of a previous command message for a data transfer operation, all or a portion of which involves the data message and when the routing logic accesses additional tables within the storage-shelf-router integrated circuit and determines that the entity which sent the command message is not authorized to direct data to a data-storage device interconnected to the storage-shelf router

26. The storage-shelf-router integrated circuit of claim 15 wherein, when the routing logic accesses a status message received through the second communications-medium port, the routing logic

routes the status message to the first communications-medium port when the first entity is not a remote device external to the storage shelf, and

routes the status message to the second communications-medium port when the first entity is a remote device external to the storage shelf.

27. The storage-shelf-router integrated circuit of claim 15 wherein, when the routing logic accesses a storage-shelf-internal-management message received through the second communications-medium port, the routing logic

routes the storage-shelf-internal-management message to one of the one or more processors when a destination address of the storage-shelf-internal-management message matches the unique number assigned to the storage-shelf-router integrated circuit,

routes the storage-shelf-internal-management message to the first communications-medium port when the destination address of the storage-shelf-internal-management message is less than the unique number assigned to the storage-shelf-router integrated circuit and the first entity is not a remote device external to the storage shelf, and

routes the storage-shelf-internal-management message to one of the one or more processors when the routing logic determines that the storage-shelf-internal-management message needs error handling.

28. A storage-shelf-router integrated circuit of claim 9

wherein each of the number of data-storage devices is an Advanced Technology Attachment disk drive,

wherein each of the communications media is a fibre channel arbitrated loop.

29. A storage-shelf-router integrated circuit of claim 9

wherein each of the communications media is a fibre channel arbitrated loop,

wherein each of the number of data-storage devices is a Serial Advanced Technology Attachment disk drive, and

wherein the number of data-storage-device-link-port components are Serial Advanced Technology Attachment ports.

30. A routing logic component within a local storage-shelf router, included within a storage shelf, that includes a first port to a first communications medium, a second port to a second communications medium, a command and error processing component, and a data-storage-link-port layer, the routing logic component comprising:

destination logic that determines whether a message received from one of the first port and the second port is directed to the local storage-shelf-router, to a remote storage shelf router intercommunicating with the local storage router, or to a remote entity external to the storage shelf; and

routing logic that routes a message received from one of the first port and the second port to one of the first port and second port in order to forward the message to a remote storage-shelf router when the destination logic determines that the message is directed to the remote storage-shelf router, that routes a message received from one of the first port and the second port to one of the first port and second port in order to forward the message to a remote entity external to the storage shelf when the destination logic determines that the message is directed to the remote entity external to the storage shelf, and that routes the message received from one of the first port and the second port to one of the command and error processing component or to the data-storage-link-port layer when the destination logic determines that the message is directed to the local storage-shelf router.

31. The routing logic component of claim 30

wherein the routing logic component accesses a routing table within the storage-shelf router that lists, for each of a number of data-storage devices interconnected through the data-storage-link-port layer to the storage-shelf router, a first-communications-medium address associated with the data-storage device, a second-communications-medium address associated with the data-storage device, and additional information related to data-storage-device addresses supported by the data-storage device,

wherein the storage-shelf router is assigned a unique number and is linked through the first port to a first entity and is linked through the second port to a second entity,

wherein the first entity is one of

a remote device external to the storage shelf, and

a storage-shelf router having a unique number less than the assigned unique number, and

wherein the second entity is one of

a remote device external to the storage shelf, and

a storage-shelf router having a unique number greater than the assigned unique number.

32. The routing logic component of claim 31 wherein, when the routing logic component accesses a command message received through the first port, the routing logic component

routes the command message to the command and error processing component when a destination address within the command message matches a first-communications-medium address in the routing table,

routes the command message to the second port when the destination address within the command message does not match a first-communications-medium address in the routing table, and the second entity is not a remote device external to the storage shelf,

routes the command message to the first port when the destination address of the command message does not match a first-communications-medium address in the routing table, and the second entity is a remote device external to the storage shelf, and

routes the command message to the command and error processing component when the routing logic component determines that the command message needs error handling.

33. The routing logic component of claim 32 wherein the routing logic component determines that the command message needs error handling when the routing logic component accesses additional tables within the storage-shelf-router integrated circuit and determines that the entity which sent the command message is not authorized to direct a command to a data-storage device interconnected with the storage-shelf router.

34. The routing logic component of claim 31 wherein, when the routing logic component accesses a data message received through the first port, the routing logic component

routes the data message to the data-storage-link-port layer when a destination address within the data message matches a first-communications-medium address in the routing table,

routes the data message to the second port when the destination address within the data message does not match a first-communications-medium address in the routing table, and the second entity is not a remote device external to the storage shelf,

routes the data message to the first port when the destination address within the data message does not match a first-communications-medium address in the routing table, and the second entity is a remote device external to the storage shelf, and

routes the data message to the command and error processing component when the routing logic component determines that the data message needs error handling.

35. The routing logic component of claim 34 wherein the routing logic component determines that the data message needs error handling when the routing logic component accesses additional tables within the storage-shelf router and determines that no context has been created within shared memory during processing of a previous command message for a data transfer operation, all or a portion of which involves the data message and when the routing logic component accesses additional tables within the storage-shelf router and determines that the entity which sent the command message is not authorized to direct data to a data-storage device interconnected to the storage-shelf router.

36. The routing logic component of claim 31 wherein, when the routing logic component accesses a status message received through the first port, the routing logic component

routes the status message to the second port when the second entity is not a remote device external to the storage shelf, and

routes the status message to the first port when the second entity is a remote device external to the storage shelf.

37. The routing logic component of claim 31 wherein, when the routing logic component accesses a storage-shelf-internal-management message received through the first port, the routing logic component

routes the storage-shelf-internal-management message to the command and error processing component when a destination address within the storage-shelf-internal-management message matches the unique number assigned to the storage-shelf router,

routes the storage-shelf-internal-management message to the second port when the destination address within the storage-shelf-internal-management message is greater than the unique number assigned to the storage-shelf router and the second entity is not a remote device external to the storage shelf, and

routes the storage-shelf-internal-management message to the command and error processing component when the routing logic determines that the storage-shelf-internal-management message needs error handling.

38. The routing logic component of claim 31 wherein, when the routing logic component accesses a command message received through the second port, the routing logic component

routes the command message to the command and error processing component when a destination address within the command message matches a second-communications-medium address in the routing table,

routes the command message to the first port when the destination address within the command message does not match a second-communications-medium address in the routing table, and the first entity is not a remote device external to the storage shelf,

routes the command message to the second port when the destination address of the command message does not match a second-communications-medium address in the routing table, and the first entity is a remote device external to the storage shelf, and

routes the command message to the command and error processing component when the routing logic component determines that the command message needs error handling.

39. The routing logic component of claim 38 wherein the routing logic component determines that the command message needs error handling when the routing logic component accesses additional tables within the storage-shelf-router integrated circuit and determines that the entity which sent the command message is not authorized to direct a command to a data-storage device interconnected with the storage-shelf router.

40. The routing logic component of claim 31 wherein, when the routing logic component accesses a data message received through the second port, the routing logic component

routes the data message to the data-storage-link-port layer when a destination address within the data message matches a second-communications-medium address in the routing table,

routes the data message to the first port when the destination address within the data message does not match a second-communications-medium address in the routing table, and the first entity is not a remote device external to the storage shelf,

routes the data message to the second port when the destination address within the data message does not match a second-communications-medium address in the routing table, and the first entity is a remote device external to the storage shelf, and

routes the data message to the command and error processing component when the routing logic component determines that the data message needs error handling.

41. The routing logic component of claim 34 wherein the routing logic component determines that the data message needs error handling when the routing logic component accesses additional tables within the storage-shelf router and determines that no context has been created within shared memory during processing of a previous command message for a data transfer operation, all or a portion of which involves the data message and when the routing logic component accesses additional tables within the storage-shelf router and determines that the entity which sent the command message is not authorized to direct data to a data-storage device interconnected to the storage-shelf router.

42. The routing logic component of claim 31 wherein, when the routing logic component accesses a status message received through the second port, the routing logic component

routes the status message to the first port when the first entity is not a remote device external to the storage shelf, and

routes the status message to the second port when the first entity is a remote device external to the storage shelf.

43. The routing logic component of claim 31 wherein, when the routing logic component accesses a storage-shelf-internal-management message received through the second port, the routing logic component

routes the storage-shelf-internal-management message to the command and error processing component when a destination address within the storage-shelf-internal-management message matches the unique number assigned to the storage-shelf router,

routes the storage-shelf-internal-management message to the first port when the destination address within the storage-shelf-internal-management message is greater than the

unique number assigned to the storage-shelf router and the first entity is not a remote device external to the storage shelf, and

routes the storage-shelf-internal-management message to the command and error processing component when the routing logic determines that the storage-shelf-internal-management message needs error handling.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.